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RESPONSE OF RICE TO POTASSIUM FERTILIZER AND ITS APPARENT BALANCE IN OLD BRAHMAPUTRA FLOOD PLAIN AND TERRACE SOIL

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Abstract

A field study on the effect of K on Boro and T. aman rice was conducted at Bangladesh Agricultural University, Mymensingh and BADC Farm, Madhupur, Tangail during 2007 to 2009. The objectives were to see the response of rice to K application and to determine the optimum K dose and K balance for better understanding of K management in wet land rice. Six levels of potassium viz. 0, 30, 60, 90, 120 and 150 kg K ha^{-1} were tested. The trials were laid out in randomized block design (RCBD) with three replications. Nitrogen, P and S were applied as blanked dose. Rice yield increased with K application in both the seasons at both the locations. The response of rice to applied K followed quadratic trend. The economic optimum rate of potassium for the two locations varied from 90 to 125 kg K ha^{-1} for T. aman rice and 96 to 141 kg K ha^{-1} for Boro rice. The K uptake was higher in Boro rice than in T. aman rice. The apparent K recovery gradually decreased with increasing the rate of K application. The highest K (61 to 95%) was recovered from the treatment of 30 kg K ha^{-1}. The negative K balance was found up to 150 kg K ha^{-1} with diminishing magnitude.

Introduction

Potassium nutrition of agricultural crops in Bangladesh depends mainly on soil K resources and K fertilizer imports. The consumption of K by rice is highest among the essential nutrient elements as exerts a balancing effect on both N and P. VonUexkull (1978) reported that modern rice varieties removed much higher K than P and some times more than N.

Farmers in Bangladesh use extremely low amount of K and sometimes no K fertilizer for rice cultivation. The necessity of K fertilizer in Bangladesh agriculture, practically for rice cultivation is often questioned by many farmers and policy makers. This is mainly because of that the use of K does not always show visible changes in vegetative growth of rice as often observed with the use of N. Moreover, deficiency symptoms of K in rice are less conspicuous than N and S.

Intensive cropping and use of modern rice verities for high yield caused heavy depletion of K in soil, particularly in absence of K application (Tiwari, 1985). Mohanty and Mondal (1989) reported a negative K balance in rice systems at many sites in India. The present experiments were conducted on Boro-T. aman rice cropping system in Old Brahmaputra Flood Plain and Terrace soils to investigate the response of rice to K application and K balance.

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Materials and Methods

Four field trials were conducted at BAU farm, Mymensingh and BADC farm, Madhupur, Tangail during 2007 to 2009. BAU farm soils of fall under Sonatola series and that of BADC farm under Noadda series. The texture of the soils was silt loam to clay loam. The pH was 4.83 to 6.53 having organic matter content of 1.89 to 2.65% and exchangeable K of 0.087 to 0.097 cmol kg^{-1} soil. CEC, Available P, S, total N and CEC were higher in BADC farm soil. The exchangeable Ca and Mg were higher in BAU farm soils than BADC farm soils (Table 1). Mica was higher in BADC farm soil (33-35%) while vermiculite was higher in BAU farm soil (14-18%) (Table1). The trials were laid in randomized block design (RCBD) with 3 replications. There were six levels of K viz. 0, 30, 60, 90, 120 and 150 kg ha^{-1}. Nitrogen, P and S were applied as blanket dose on soil test. The doses for T. aman rice were 67N: 14P: 5S kg ha^{-1} for BAU farm soil and only 60 kg Nha^{-1} for BADC farm soil. The doses for boro rice were 189N: 36P: 10S kg $ha^{-1}$for BAU farm soil and only 167 kg Nha^{-1} for BADC farm soil. The status of P and S in BADC farm soil was high hence not applied in either of the crops. The test rice varieties were BRRI dhan 41 in T. aman and BRRI dhan 29 in Boro seasons. The unit plot size was 5m × 4m. Two healthy seedlings/hill were transplanted at a spacing of 20 cm × 20 cm. Full doses of P and S was applied at the time of final land preparation. Nitrogen was applied in 3 equal splits; at 12 days after transplantation, at active tillering stage and rest at panicle initiation stage. The T. aman rice was transplanted in the 3rd week of July and Boro rice in the 2nd week of February. Plant protection measures and cultural practices were followed throughout the growing period. The crops were harvested at maturity of rice from a 5 m × 1m area in each plot. The grain yield was recorded at 14% moisture content on an oven dry basis and it was expressed in t ha^{-1}. Mean separation was done by Duncan's multiple range tests. Regression analysis was done between K rate and yield of rice. Maximum K rate and the economic optimum rate of K for rice were estimated following the equation of Gomez and Gomez (1984) as;

$$K\max = -\frac{b}{2c}$$

Where b and c are the numerical constants in quadratic equations of response functions,

$$Kopt = \frac{(\frac{pf}{py} - b)}{2c}$$

Where P_f and P_y are prices of K (Tk.35/kg), rice grain (Tk.20/kg), respectively.
Grain and straw samples were dried in an oven at 70°C for 72 hrs and ground in Willey mill. The samples were analyzed for K content following method of Yoshida *et al.* (1976) and K uptake was calculated.

Agronomic K use efficiency was calculated using the formula;

$$\text{Agronomic K use efficiency (kg grain per kg)} = \frac{(Yk\text{-}Yo)\ kg\ ha^{-1}}{K\ applied\ (kg\ ha^{-1})}$$

Where, Y_k = Grain yield in K treated plots ($kgha^{-1}$), Y_0 = Grain yield in K controlled plots (kg ha^{-1})

Table 1. Chemical and mineralogical properties of BAU and BADC farm soils (0-15 cm)

Soils	Chemical properties										
	pH	Organic carbon (%)	Exchangeable K(cmol kg^{-1} soil)	Calcium (cmol kg^{-1} soil)	Magnesium (cmol kg^{-1} soil)	CEC(cmol kg^{-1} soil)	Potassium saturation (%)	Total N (%)	Phosphorus (mg kg^{-1} soil)	Sulfur (mg kg^{-1} soil)	
BAU	6.72	0.77	0.087	4.00	0.44	11.12	1.92	0.06	2.47	20.49	
BADC	4.83	0.87	0.097	1.50	0.17	9.50	5.49	0.092	29.05	26.22	
	Mineralogical properties										
Soils	Mica	Vermiculite	Chloride	Kaolinite	Vermiculite Smectite	Vermiculite-Smectite	Interstratified Mica-Chloride	Quartz	Goethite	Lepidocrrocite	Feldapar
BAU	24.00	18.00	17.00	7.00	18.00	-	6.00	3.00	2.00	4.00	1.00
BADC	33.00	-	6.00	19.00	7.00	26.00	-	7.00	1.00	-	1.00

Rain and irrigation water was also collected during the growing crop period of crop and analyzed for K. Percolation water (L m^{-2}) was calculated using the formula $Q= - K_W AT. \Delta\Psi_h/\Delta z$ given by Hanks and Ashcroft (1960).

Where,
Q = Quantity of water

K_w = Hydraulic conductivity

A = area

T = Time

h = Difference in hydraulic potential and

Z = Difference between two points taking 0 to downward as negative.

The hydraulic potential was again calculated by adding the component potentials as $\Psi_h= \Psi_m+ \Psi_p+ \Psi_z$ where h, m, p, and z represent hydraulic, metric, pressure and gravitational potentials. Negative Q was considered as downward movement of water.

Water balance (Input minus out put) was made fortnightly for a period of two years during T.aman and Boro seasons using simple equation; Water balance = Input – output

Input = Rainfall + irrigation + initial soil content

Output = ET + percolation / drainage losses

Apparent K recovery was calculated. After 2 years, apparent K balance was estimated from K uptake and leaching loss data. The mean apparent K balance was calculated using the following simple equation;

$$Ka = (Kf + Kr + Ki) - (Kupt + Kl)$$

where,

Ka= apparent K balance (kgha^{-1})
Kf= K added through fertilizer (kgha^{-1})
Kr= K added through rainfall (kgha^{-1})
Ki = K added through irrigation (kgha^{-1})
Kupt= K uptake by crop (kgha^{-1})
Kl = K lost through leaching (kgha^{-1})

Results and Discussion

Grain yield: The initial K status of BAU soil (0.087 cmol kg^{-1} soils) was below the critical limit of 0.12 cmol kg^{-1} as suggested by BARC (2005). Application of 30 kg K ha^{-1} in this soil did not significantly increase the yields over the control in 2007. Sixty kg K ha^{-1} increased the grain yield over 30 kg K ha^{-1} but it was significant only in 2007 (Fig.1). Application of K up to 90 kg ha^{-1} showed significant increase in both years over 60 kg K ha^{-1}. Further increasing the K rate from 120 to 150 kg ha^{-1} no significant increase in grain yields was noticed over 90 kg K ha^{-1}. In BADC farm soil, 60 kg K ha^{-1} significantly increased the grain yield over lower doses. The yield increase due to successive increase in K levels from 90 to 150 kg ha^{-1} was not significant over 60 kg K ha^{-1}. In both years, BAU farm soil produced a significant yield increase from 60 kg K ha^{-1} to 120 kg K ha^{-1} whereas the grain yields being statistically identical for 90 to150 kg K ha^{-1}. In boro season, the grain yield progressively increased up to 120 kg K ha^{-1} and

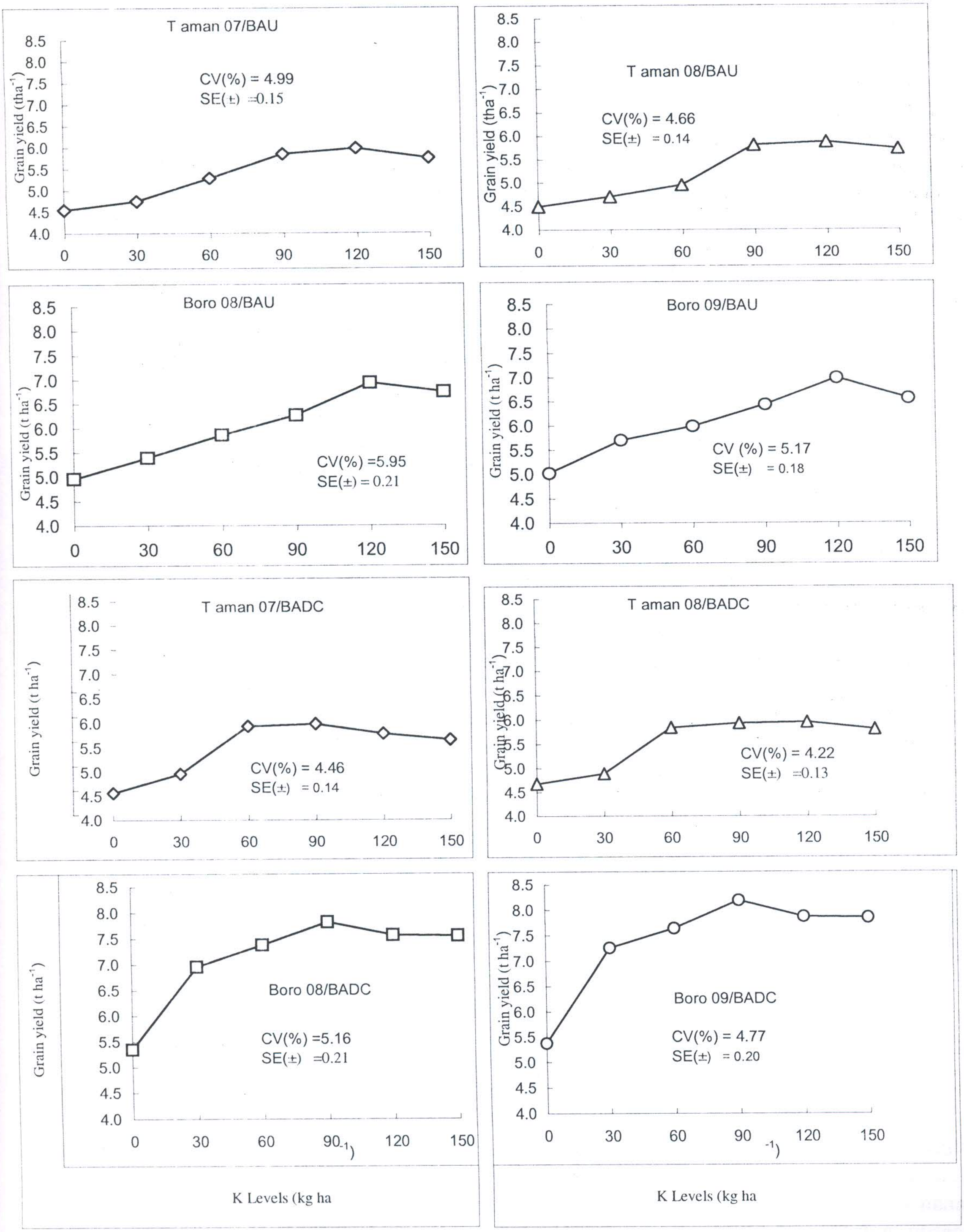

Fig. 1. Effects of K on grain yield of T. aman and Boro rice at BAU and BADC farm

thereafter, no increase was noticed in BAU farm (Fig. 1). Grain yield of BADC farm soil was significantly influenced by increased levels of K up to 60 kg ha^{-1} (Fig. 1). Ninety kg K ha^{-1} showed the best performance in producing grain yield over other treatments although it was statistically identical to 60, 120 and 150 kg K ha^{-1}(Fig. 1).Soils of BAU and BADC farms showed remarkable variation in mineralogy, fate of K and K fertility (Table1). BAU farm soil contained vermiculite. Potassium in this soil (native and added) remained mainly in non-exchangeable form as a consequence the exchangeable K, K release capacity and solution K was lower. Parvin *et al*. (2007) worked with similar soil and obtained results are in agreement with the results. The dominant mineral in BADC farm soil was mica and most of its K remained in exchange form. The K release capacity, solution K as well as K fertility of this soil was higher than BAU farm soils. Because of this higher K fertility of BADC farm soil, it required lesser amount of fertilizer compared to BAU farm soil for producing higher yield. Application of K increased the rice yield consistently up to 120 kgha^{-1} of applied K (Saleque *et al*., 1998). Singh and Patirum (1987) reported 100 kg K/ha for optimum and 187 kg Kha^{-1} for maximum for rice yields in Meghalaya, India. Ahsan *et al.* (1997) tested 5 levels of K (0, 30, 60, 90 and 120 kgha^{-1}) and reported that rice yield was increased with K fertilizer application in both dry and wet seasons. A regression analysis showed that at both soils, rice responded quadratically to K application in terms of grain yield (Fig. 2).

The quadratic functional relationship between K application and grain yield in T. aman and Boro rice was significant with coefficient determination of 0.91 to 0.95. A quadratic response of rice to K fertilizer was also reported in India by Singh and Patirum (1987).

K maximum and K optimum: The maximum dose and economic optimum dose of K calculated from the response equation (Fig.2 & Table 2) showed that the predicted maximum rate of K varied from 104 kgha^{-1} to 167 kgha^{-1} and economic optimum K dose varied from 92 kgha^{-1} to 141 kgha^{-1} in both soils. The values were much higher than the BARC (2005) recommended dose of K for that area. Singh and Patirum (1987) reported that 100 kg Kha^{-1} for optimum and 187 kg Kha^{-1} for maximum rice yield in Meghalaya, India.

Table 2. K maximum and K optimum for T. aman and Boro rice

Locations	K maximum (kg ha^{-1})		K optimum (kg ha^{-1})	
	T. aman	Boro	T. aman	Boro
BAU farm	153	167	126	141
BADC farm	104	107	92	96

K uptake by rice: In T. aman season, K uptake varied from 94.18 to 153.27 kg ha^{-1} and 76.95 to 139.54 kg ha^{-1} in 2007 and 2008, respectively at BAU farm soil. In BADC farm soil, the K uptake by T. aman during 2007 to 2008 followed almost the similar trend as in BAU farm soil. Uptake of K by Boro rice was similar to K uptake by T. aman rice in both soils. Potassium uptake significantly increased with increasing levels of K in both soils and seasons leading to higher straw yield coupled with grain yield (Fig. 3). The K concentration in grain and straw of T. aman (BRRI dhan 41) and Boro (BRRIdhan 29) was almost similar. But the straw yield of T. aman was higher than Boro. As a result of which, the uptake was higher in T. aman. In boro season, nutrient uptake was lower in BADC farm compared to BAU farm because of higher yield. The findings are in agreement with the results of Devendra *et al*. (1999), Hu *et al*. (2004) and Pattanayak *et al*. (2008).

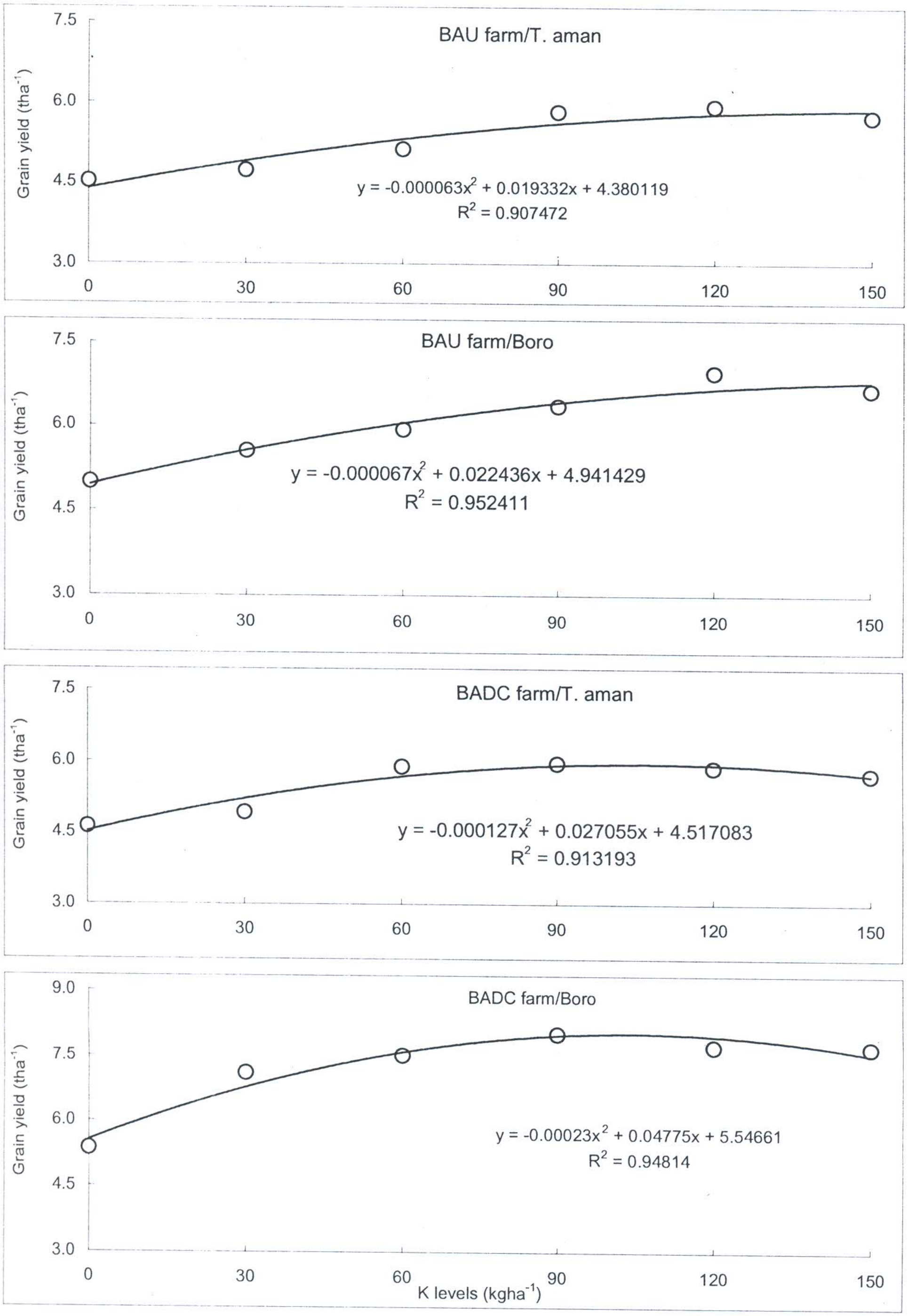

Fig.2. Response of rice to potassium application

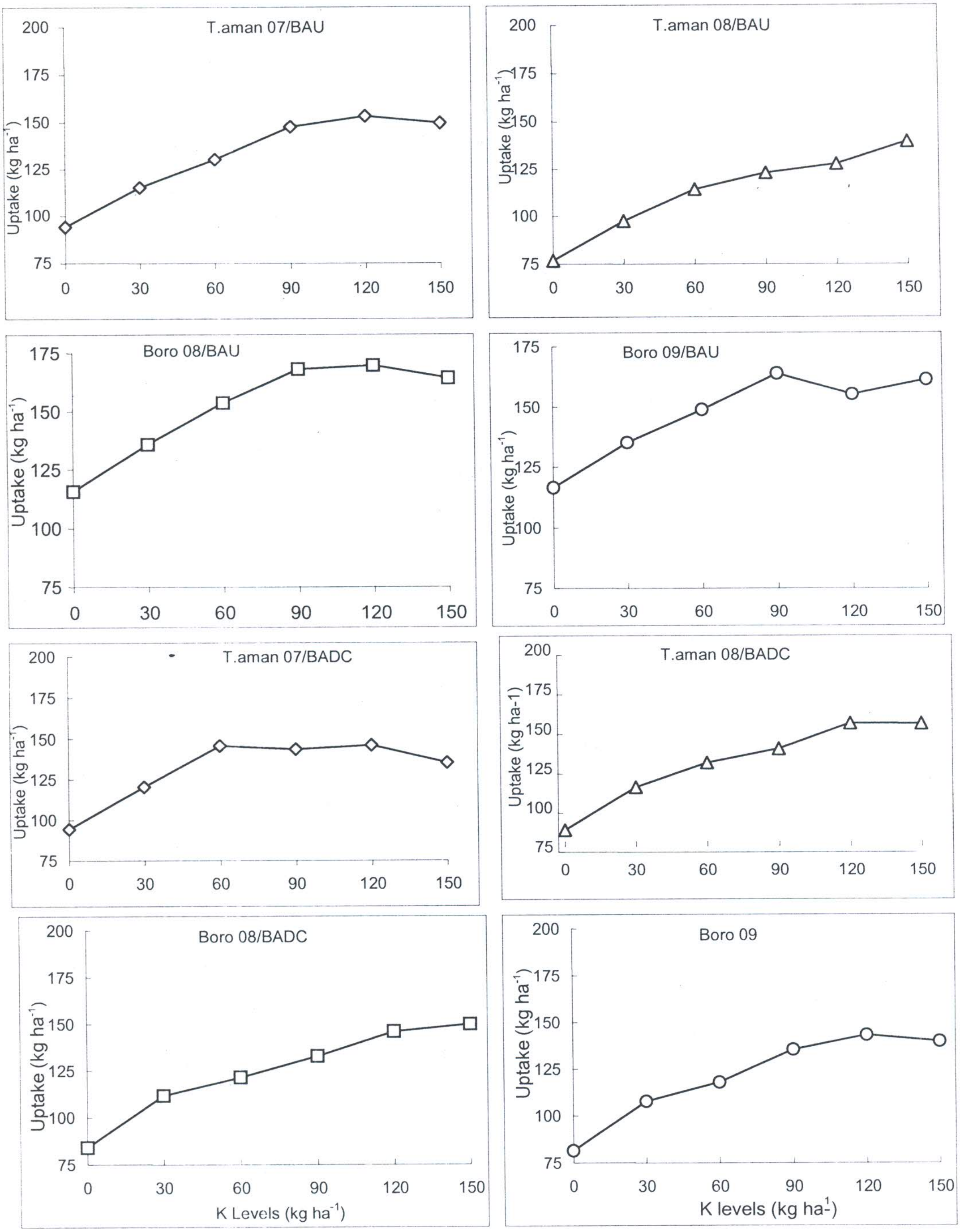

Fig. 3. Effects of K on K uptake by T. aman and Boro rice at BAU and BADC farm

Agronomic potassium use efficiency: In T. aman season, the agronomic potassium use efficiency increased up to 60 kg K ha^{-1} in BAU farm soil and thereafter, the K use efficiency gradually decreased with increasing K application upto 150 kg K ha^{-1} (Table 3). The variation in K use efficiency between years was very negligible in a particular soil. The K use efficiency in BADC farm soil and BAU farm soil was nearly or almost similar and its trend between the soils for different levels of K was also similar. In general, the K use efficiency of Boro rice grown in BAU and BADC farms was highest at 30 kg ha^{-1} level of K in all years (Table 3). Between the two soils, the K use efficiency in BADC farm soil was higher than BAU farm soil. The results were supported by the findings of Saleque *et al.* (1998).

Apparent recovery percent of potassium from applied potassium: The percent apparent K recovery (Kilogram K uptake per kilogram of added K) exhibited decreasing trend with increasing applied K levels in both the soils for both T. aman and Boro season (Tables 3). In general, the higher percent apparent K recovery was noticed in the 30 kg K ha^{-1} receiving plots compared to other treated plots. In T. aman season, the percent K recovery varied from 25.11 to 121.32 % in BAU farm soils and 27.54 to 90.39 % in BADC farm soils. In Boro season, it varied from 29.70 to 81.27 % in BAU farm soils and 22.82 to 94.82 % in BADC farm soils. In T. aman season, the highest apparent K recovery was 121.32 % in K_{30} treated plot in BAU farm soil in 2007 where the lowest was 25.11 % in K_{150} treated plot in the same soil in 2008. Similar type of results was found by Vipin and Prasad (2003), Hu (2004) and Mazid *et al.* (2008).

Potassium input through rain water: Two rain samplers were installed besides the experimental sites. One was at BAU farm and another one at BADC farm. Rain water was collected after each rain event and immediately analyzed for K. Data on rainfall amount, K concentration in rain water and input of K through rain water has been presented in Table 4.

During the T. aman season in 2007 and 2008 rainfall was 702.30 mm and 737.00 mm at BAU farm and 504.15 mm and 560.76 mm in BADC farm, respectively (Table 4).The K concentration in rain water was 0.34 to 0.35 mg L^{-1} at BAU farm while it was 0.53 to 0.54 mg L^{-1} at BADC farm (Table 4). The amount of added K from rain water was 2.46 & 2.51 kg ha^{-1} at BAU farm, and 2.79 & 2.97 kg ha^{-1} at BADC farm in T. aman season of 2007 and 2008, respectively (Table 4).

During the Boro season, the amount of rainfall was 327.70 and 392.80 mm in BAU farm, and 274.55 and 208.90 mm in BADC farm in 2008 and 2009, respectively (Table 4). The concentration of K in rain water was 0.96 and 0.97 mg L^{-1} at BAU farm while it was 1.02 and 1.03 mg L^{-1} at BADC farm in 2008 and 2009, respectively (Table 4). The addition of K through rain water was 3.15 to 3.77 kg ha^{-1} at BAU farm but it was 2.15 to2.80 kg ha^{-1} at BADC farm (Table 4). In remote areas from sea the concentration in rain water is mainly influenced by the dust particles emitted to the air from soil by wind. Rain events and amount of rainfall also remarkably influence the concentration. In boro season the amount and events of rainfall was very low but the amount of dust particle was very high which resulted the obtained higher concentration in both locations. The obtained lower K concentration In T. aman season was due to dilution by higher rainfall.

Potassium input through irrigation water: Irrigation water was applied to the experimental plots from deep tube well (DTW) near the experimental sites at both farms. The amount of irrigation water was measured by using V-Notch weir method (Khurmi, 1987). Water samples were

Table 3. Effects of K on agronomic use efficiency and apparent recovery of T. Aman and Boro rice at BAU and BADC farm

K levels (kgha^{-1})	Agronomic use efficiency (kg grain per kg K)								Apparent K recovery (%)							
	T. aman				Boro				T. aman				Boro			
	BAU		BADC		BAU		BADC		BAU		BADC		BAU		BADC	
	2007	2008	2007	2008	2008	2009	2008	2009	2007	2008	2007	2008	2008	2009	2008	2009
0	6.78	6.77	13.00	7.11	14.33	22.67	53.67	62.67	-	-	-	-	-	-	-	-
30	12.39	7.61	22.78	19.33	15.00	16.17	33.83	37.67	75.80	67.10	89.58	90.39	72.20	61.26	94.82	88.75
60	14.48	14.56	15.70	13.89	14.56	15.67	27.44	31.22	63.66	60.77	86.45	71.34	64.73	54.18	61.93	61.49
90	12.00	11.47	10.11	10.58	16.50	16.33	18.50	20.75	61.02	50.55	57.48	57.16	60.12	52.27	54.00	60.19
120	8.04	8.18	7.22	7.51	11.93	10.27	14.67	16.47	50.80	42.63	43.37	56.65	46.08	32.02	51.67	51.90
150	6.98	6.88	13.60	7.21	14.53	22.97	53.87	62.87	38.01	41.50	24.54	47.22	33.30	30.01	43.85	39.04

collected during each irrigation and analyzed for K. Data on the amount of irrigation water, K concentration in irrigation water and addition of K through irrigation water have been presented in Table 4.

In T. aman season, little amount of irrigation water was required compared to Boro season because of higher rainfall of 703 to 737 mm at BAU farm and 504 to 560 mm at BADC farm. During this season, an amount of 173 to 210 mm irrigation water was applied at BAU farm in different plots and years. But at BADC farm it varied from 143 to 160 mm. In Boro season, the irrigation water varied from 341 mm to 343 mm at BAU farm and a higher amount of 381 to 414 mm at BADC farm. The variation between the locations and years was mainly due to variation in amount and rain events.

The mean concentration of K in irrigation water was 1.60 mg L^{-1} at BAU farm while it was 1.80 mg L^{-1} at BADC farm in T. aman season. The addition of K was higher in Boro season than in T. aman season because of higher amount of irrigated water. The concentration of K in irrigation water and its addition in BADC farm was higher than BAU farm for higher irrigation mainly.

Potassium balance: Potassium balance was influenced remarkably due to application of K in both T. aman and Boro seasons of 2007 to 2009 at BAU and BADC farms. The balance was negative irrespective of K levels, seasons and soils (Table 5).

In T. aman season, a very small amount of 2.94 and 2.99 kg K ha^{-1} was added from rain and irrigation water, respectively to BAU farm soil. The total gain of K varied from 5.92 to 155.92 kg ha^{-1} depending on K levels. On the other hand, leaching loss of K with percolation water and crop uptake varied from 12.10 to 89.35 kg ha^{-1} and 84.73 to 144.36 kg ha^{-1}, respectively. As a consequence total loss of K was 96.83 to 233.71 kg ha^{-1}. The lowest and the highest gain and loss was in K_0 and K_{150} treated plots, respectively. As the total loss of K was much higher than the total gain, a considerable amount of K was lost from the native sources. The negative balance of K was almost constant upto 120 kg K ha^{-1} levels but at 150 kg K ha^{-1} the loss of native K was lower than others because the uptake by crop was less compared to 120 kg K ha^{-1}.

In BADC farm soil the input of K was 5.61 to 155.61 kg ha^{-1} irrespective of soils in two years where more than 2.88 and 2.73 kg K ha^{-1} was added from rain and irrigation water, respectively. The rest was added from fertilizer. Depending on the different levels of K, the leaching loss of K with percolation water varied from 6.59 to 89.59 kg ha^{-1} in BADC farm soil. The total loss gradually increased with increased levels of K but the rate of loss decreased. The negative balance of K showed an increasing trend up to 60 kg K ha^{-1} level and thereafter it did not change remarkably up to 150 kg K ha^{-1} level.

In Boro season, the input of K to BAU farm soil from rain (3.48 kg ha^{-1}) and irrigation water (5.51 kg ha^{-1}) during the Boro season was negligible although it was higher than the amount added in T. aman season. The leaching loss through percolation water increases with increasing K levels ranging from 5.69 to 66.19 kg ha^{-1}. The crop uptake was 115.26 to 165.84 kg K ha^{-1}. As such total output of K varied from 120.95 to 228.93 kg ha^{-1}. The higher total loss compared to total gain indicates that a considerable amount of K was lost from native source of soil. The maximum and minimum gain and loss was in 0 and 150 kg K ha^{-1} levels respectively. The crop uptake was higher than leaching loss. The negative balance of K varied from -69.94 to -111.96 kg K ha^{-1}. The negative balance of K decreased with increasing K up to 150 kg K ha^{-1}.

Table 4. Addition K through rainfall and irrigation water during the growing period of T. aman and Boro rice at BAU farm and BADC farm

Rice growing seasons	Rice growing years	Rainfall						Irrigation water					
		Amount (mm)		K conc. (mgL^{-1})		K added ($kgha^{-1}$)		Amount (mm)		K conc. (mgL^{-1})		K added ($kgha^{-1}$)	
		BAU	BADC	BAU	BADC	BAU	BADC	BAU	BADC	BAU	BADC	BAU	BADC
T. aman	2007	737.00	560.76	0.34	0.53	2.51	2.97	173.00	143.00	1.60	1.80	2.77	2.57
	2008	702.80	504.15	0.35	0.54	2.46	2.79	210.00	160.30	1.60	1.80	3.36	2.89
Boro	2008	327.70	274.55	0.96	1.02	3.15	2.80	341.08	380.77	1.61	1.81	5.49	6.89
	2009	392.80	208.90	0.97	1.03	3.77	2.15	342.90	413.66	1.61	1.81	5.52	7.48

Table 5. Mean balance of potassium (kg ha^{-1}) for T. aman and Boro rice at BAU and BADC farms (2007-2009)

K levels (kg/ha)	Input (kg/ha)				Output (kg/ha)			Balance (kg/ha)
	K from fertilizer	K from rainfall	K from irrigation	Total	Leaching loss	Crop uptake	Total	
T. aman season								
BAU farm								
0	0.00	2.94	2.99	5.92	12.10	84.73	96.83	-90.91
30	30.00	2.94	2.99	35.92	24.08	106.17	130.25	-94.33
60	60.00	2.94	2.99	65.92	38.00	122.06	160.06	-94.14
90	90.00	2.94	2.99	95.92	55.34	134.94	190.28	-94.36
120	120.00	2.94	2.99	125.92	79.44	140.79	220.22	-94.30
150	150.00	2.94	2.99	155.92	89.35	144.36	233.71	-77.79
BADC farm								
0	0.00	2.88	2.73	5.61	6.59	89.71	96.30	-90.61
30	30.00	2.88	2.73	35.61	24.96	116.70	141.66	106.05
60	60.00	2.88	2.73	65.61	36.05	137.04	173.09	107.09
90	90.00	2.88	2.73	95.61	53.56	141.29	194.85	-99.24
120	120.00	2.88	2.73	125.61	61.52	149.71	211.24	-85.63
150	150.00	2.88	2.73	155.61	89.59	145.77	235.36	-79.75
Boro season								
BAU farm								
0	0.00	3.48	5.51	8.99	5.69	115.26	120.95	111.96
30	30.00	3.48	5.51	38.99	15.43	135.28	150.70	111.71
60	60.00	3.48	5.51	68.99	22.57	150.93	173.50	-04.51
90	90.00	3.48	5.51	98.99	30.67	165.84	196.51	-97.52
120	120.00	3.48	5.51	128.99	45.35	162.12	207.46	-78.47
150	150.00	3.48	5.51	158.99	66.19	162.73	228.93	-69.94
BADC farm								
0	0.00	2.38	7.19	9.57	3.58	82.48	86.06	-76.49
30	30.00	2.38	7.19	39.57	14.59	110.02	124.60	-85.03
60	60.00	2.38	7.19	69.57	20.80	119.50	140.30	-70.73
90	90.00	2.38	7.19	99.57	32.58	133.86	166.44	-66.87
120	120.00	2.38	7.19	129.57	39.29	144.62	183.91	-54.34
150	150.00	2.38	7.19	159.57	46.89	144.65	191.54	-31.97

In BADC farm soil, the total input was 9.57 to 159.57 kg K ha^{-1} where 2.48 kg K ha^{-1} was added from rain water and 7.19 kg K ha^{-1} from irrigation water in addition to fertilizer. The leaching loss of K through percolation water was 3.58 to 46.89 kg ha^{-1} depending on K levels. The crop uptake of K was 82.48 to 144.65 kg ha^{-1} while total loss of K was 86.06 to 191.54 kg ha^{-1}. The input, leaching loss, uptake and total K loss increased as the levels of K increased. The rate of leaching loss of K was inconsistent for different levels of K. The leaching loss as well as crop uptake was relatively low in BADC farm soil. As a consequence, the negative balance of K was lower in BADC farm soil than BAU farm soil. The uptake K in general was higher than total input from different sources. In addition, more than 50% of added K was lost through leaching in all soils. As a result the balance was always negative. The results are in agreement with the findings of Ahsan *et al.* (1997); Rijpma and Jahiruddin (2004); Zhou *et al.* (2000) and Ladha *et al.* (2003).

Conclusion

The K fertility of our soil is decreasing very rapidly at alarming rate due to intensive cultivation of high yielding variety of rice with low K fertilizer dose. The BARC (2005) recommended up to 132 kg K ha^{-1} for high yield goal of rice. Our balance indicates that higher dose of K up to 150 kg K ha^{-1} improve K fertility of soil. However, considering the response of rice 60 – 90 kg K ha^{-1} may be recommended.

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